Sources of infrared (IR) radiation
Classification of electromagnetic radiation and IR radiation:
1800 – William Herschel discovered the IR radiation

1859 – Gustav Kirchhoff derived the law of thermal radiation

1893 – Wilhelm Wein derived the displacement law

1897 – Walter Nernst invented Nernst glower

1901 – Max Planck derived Planck's law
A perfect absorber for all incident radiations and also an ideal emitter

Ideal source for thermal radiation

Planck’s law: 

$$I(\lambda, T) = \frac{2hc^2}{\lambda^5} \frac{1}{e^{\frac{hc}{\lambda kT}} - 1}$$

I – intensity of corresponding wavelength at given T
h – Planck’s constant
c – speed of light
λ – wavelength
k – Boltzmann’s constant
 Wein’s displacement law: \[ \lambda_{\text{max}} = \frac{2897.8 \, \mu\text{m} \, \text{K}}{T} \]

 Stefan’s law: \[ P = \sigma \, T^4 \]

 The thermal radiation spontaneously emitted by many ordinary objects can be approximated as blackbody radiation

 Examples for black body radiators are the sun and other stars, incandescent lamps, human beings and other animals etc.
- Human beings emit IR radiation with $\lambda_{\text{max}} = 9.3 \, \mu\text{m}$

- Applications:
  - Temperature measurement
  - Infrared cameras
  - Automatic light switches
  - Anti-intruder devices
Nernst glower

- It was used to provide continuous source of IR radiation for use in spectroscopy

- A cylindrical rod or tube composed of a mixture of certain oxides such as zirconium oxide ($\text{ZrO}_2$), yttrium oxide ($\text{Y}_2\text{O}_3$) and erbium oxide ($\text{Er}_2\text{O}_3$) at a ratio of 90:7:3 by weight. Pt leads at the ends of the cylinder permit the passage of electricity

- Operates at wavelength range of 2 to 4 microns

- Has a large negative temperature coefficient of electrical resistance and preheating to about 2000$^\circ$ C was necessary
Globar

- Used as thermal light source for infrared spectroscopy

- It is a silicon carbide rod of 5 to 10 mm width and 20 to 50 mm length which is electrically heated up to 1000 to 1650 °C

- When combined with a downstream variable interference filter, it emits radiation from 4 to 15 micrometres wavelength
Quartz tungsten Halogen (QTH) lamps

- It is a popular near infrared (NIR) source

- These use a doped tungsten filaments inside a quartz envelope filled with rare gas and a small amount of halogen

- Current flowing through the filament heats tungsten to around 3000 K

- The combination of the halogen gas and the tungsten filament produces a halogen cycle chemical reaction which redeposit evaporated tungsten back onto the filament, increasing its life and maintaining the clarity of the envelope
IR lasers

- IR lasers of different wavelengths like 850 nm, 1300 nm, 1310 nm, 1550 nm and 1625 nm are available.

- CO₂ laser is used in IR spectroscopy for far IR measurements.

- Made up of a discharge tube consisting primarily of CO₂, N₂, H₂ and/or xenon and He.

- Produces a beam of infrared light with the principal wavelength bands centering around 9.4 and 10.6 micrometers.